Disclaimer

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We further caution readers that researchers at the Newfoundland & Labrador Centre for Applied Health Research are not experts on the subject topic and are relaying work produced by others. This report has been produced quickly and it is not exhaustive, nor have any included studies been critically appraised.

Airway Management: Evidence Scan

Laryngeal Mask Airways (LMA) or OroPharyngeal Airway (OPA) compared to EndoTracheal Tubes (ETT)

This evidence scan focuses on the outcomes of LMA or OPA for airway management compared to the gold standard, which is ETT. The context for this evidence scan is rural emergency departments without a physician physically present, but available through virtual care. Patient groups include both adult and pediatric populations. Forest plots from included evidence publications are included in this RDS; for a review of how to interpret forest plots, please see here for a written explanation or see here for a video explanation. Please note that references are ordered alphabetically by author in each section.

Best Practices

CADTH. **The i-gel Device for Airway Management in Remote and Isolated Settings: A Review of Comparative Clinical Effectiveness, Safety, and Guidelines**. Ottawa: CADTH; 2019 May. (CADTH rapid response report: summary with critical appraisal).

- "The evidence-based guidelines included recommendations regarding airway management. In brief, it was recommended in one guideline that it requires training to use supraglottic airway devices. Supraglottic devices are recommended in two guidelines if practitioners consider the potential benefits to outweigh the risks. The remaining five guidelines contained recommendations for different types of airway management, ranging from positional changes to laryngeal masks or tracheal intubation depending on the circumstances."

- References the following guideline documents:
    - Rehn M, et al. **Scandinavian SSAI clinical practice guideline on pre-hospital airway management**. Acta Anaesthesiol Scand. 2016;60(7):852-864. LINK
        - "We suggest that intermediately trained providers use a supraglottic airway device (SAD) or basic airway manoeuvres on patients in cardiac arrest (weak recommendation, low QoE). We recommend that advanced trained providers consider using an SAD in selected indications or as a rescue device after failed endotracheal intubation (ETI) (good practice recommendation). We recommend that ETI should only be performed by advanced trained providers (strong recommendation, low QoE). We suggest that videolaryngoscopy is considered for ETI when direct laryngoscopy fails or is expected to be difficult (weak recommendation, low QoE). We suggest that advanced trained providers apply cricothyroidotomy in 'cannot intubate, cannot ventilate' situations (weak recommendation, low QoE)."
    - Link MS, et al. **Part 7: Adult advanced cardiovascular life support: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care**. Circulation. 2015;132(18 Suppl 2):S444-464. LINK
    - Jeejeebhoy FM, et al. **Cardiac arrest in pregnancy: a scientific statement from the American Heart Association**. Circulation. 2015;132(18):1747-1773. LINK
    - Kleinman ME, et al. **Part 5: Adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care**. Circulation. 2015;132(18 Suppl 2):S414-435. LINK

Canadian Airway Focus Group. **Canadian Airway Focus Group updated consensus-based recommendations for management of the difficult airway: part 1. Difficult airway management encountered in an unconscious patient**. Can J Anaesth. 2021 Sep;68(9):1373-1404. LINK

- **Purpose**: "Since the last Canadian Airway Focus Group (CAFG) guidelines were published in 2013, the literature on airway management has expanded substantially. The CAFG therefore re-convened to examine this literature and update practice recommendations. This first of two articles addresses difficulty encountered with airway management in an unconscious patient."
- **Findings and Key Recommendations**: "Most studies comparing video laryngoscopy (VL) with direct laryngoscopy indicate a higher first attempt and overall success rate with VL, and lower complication rates. Thus, resources allowing, the CAFG now recommends use of VL with appropriately selected blade type to facilitate all tracheal intubations. If a first attempt at tracheal intubation or supraglottic airway (SGA) placement is unsuccessful, further attempts can be made as long as patient ventilation and oxygenation is maintained. Nevertheless, total attempts should be limited (to three or fewer) before declaring failure and pausing to consider "exit strategy" options. For failed intubation, exit strategy options in the still-oxygenated patient include awakening (if feasible), temporizing with an SGA, a single further attempt at tracheal

intubation using a different technique, or front-of-neck airway access (FONA). Failure of tracheal intubation, face-mask ventilation, and SGA ventilation together with current or imminent hypoxemia defines a "cannot ventilate, cannot oxygenate" emergency. Neuromuscular blockade should be confirmed or established, and a single final attempt at face-mask ventilation, SGA placement, or tracheal intubation with hyper-angulated blade VL can be made, if it had not already been attempted. If ventilation remains impossible, emergency FONA should occur without delay using a scalpel-bougie-tube technique (in the adult patient). The CAFG recommends all institutions designate an individual as "airway lead" to help institute difficult airway protocols, ensure adequate training and equipment, and help with airway-related quality reviews."

Canadian Airway Focus Group. **Canadian Airway Focus Group updated consensus-based recommendations for management of the difficult airway: part 2. Planning and implementing safe management of the patient with an anticipated difficult airway**. Can J Anaesth. 2021 Sep;68(9):1405-1436. LINK

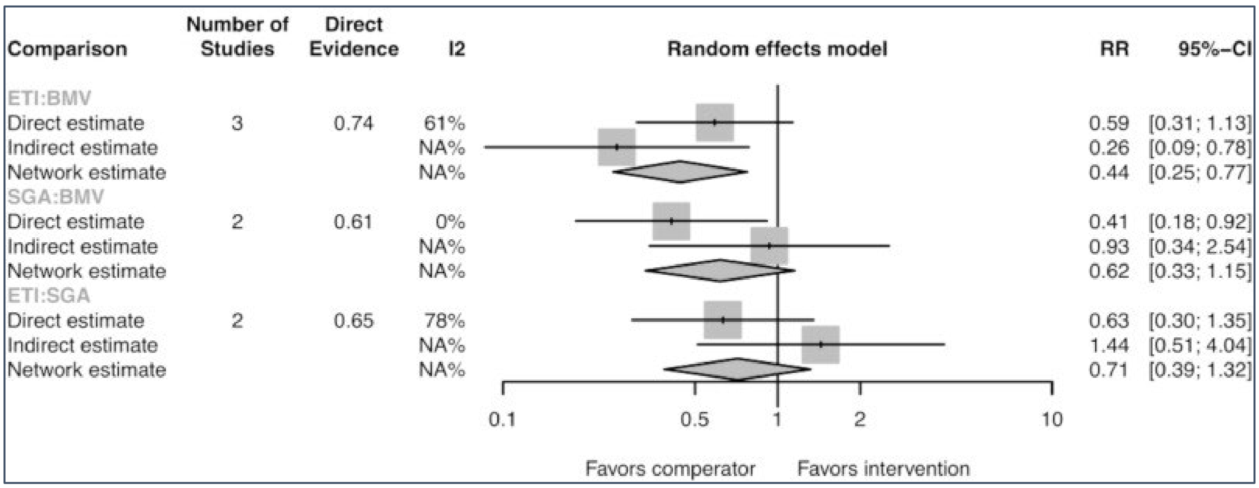
- **Purpose**: Same as Part 1 above.
- **Findings and Key Recommendations**: "Prior to airway management, a documented strategy should be formulated for every patient, based on airway evaluation. Bedside examination should seek predictors of difficulty with face-mask ventilation (FMV), tracheal intubation using video- or direct laryngoscopy (VL or DL), supraglottic airway use, as well as emergency front of neck airway access. Patient physiology and contextual issues should also be assessed. Predicted difficulty should prompt careful decision-making on how most safely to proceed with airway management. Awake tracheal intubation may provide an extra margin of safety when impossible VL or DL is predicted, when difficulty is predicted with more than one mode of airway management (e.g., tracheal intubation and FMV), or when predicted difficulty coincides with significant physiologic or contextual issues. If managing the patient after the induction of general anesthesia despite predicted difficulty, team briefing should include triggers for moving from one technique to the next, expert assistance should be sourced, and required equipment should be present. Unanticipated difficulty with airway management can always occur, so the airway manager should have a strategy for difficulty occurring in every patient, and the institution must make difficult airway equipment readily available. Tracheal extubation of the at-risk patient must also be carefully planned, including assessment of the patient's tolerance for withdrawal of airway support and whether re-intubation might be difficult."

Systematic Review Literature

Pediatric Patients

Amagasa S, et al. **Advanced airway management for pediatric out-of-hospital cardiac arrest: A systematic review and network meta-analysis**. Am J Emerg Med. 2023 Jun;68:161-169. LINK

- **Objective/Research Question**:
    - “Although airway management is important in pediatric resuscitation, the effectiveness of bag-mask ventilation (BMV) and advanced airway management (AAM), such as endotracheal intubation (ETI) and supraglottic airway (SGA) devices, for prehospital resuscitation of pediatric out-of-hospital cardiac arrest (OHCA) remains unclear. We aimed to determine the efficacy of AAM during prehospital resuscitation of pediatric OHCA cases.”
- **Results/Discussion:**
    - “Figure 3 (below). Forest plots of the direct comparison, indirect comparison, and network meta-analysis for survival. BMV was associated with survival, compared with ETI. We did not find any significant association in the other comparisons. BMV, bag-mask ventilation; ETI, endotracheal intubation; SGA, supraglottic airway, CI, confidence interval.”



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    - Table 9 (below): Network estimate for survival in sensitivity analysis: observational studies with appropriate confounding adjustment

Supplementary Table 9. Network estimate for survival in sensitivity analysis: observational studies with appropriate confounding adjustment

Comparison	Direct estimate RR (95% CI)	Indirect estimate RR (95% CI)	Network estimate RR (95% CI)	Certainty of evidence for network meta-analysis
ETI vs. BMV	0.38 (0.11–1.38)	0.08 (0.01–0.57)	0.23 (0.08–0.67)	Low
SGA vs. BMV	0.15 (0.04–0.57)	0.72 (0.11–4.87)	0.39 (0.13–1.16)	Low
ETI vs. SGA	0.53 (0.13–2.21)	2.50 (0.40–15.60)	0.59 (0.19–1.80)	Very low

BMV, bag-mask ventilation; ETI, endotracheal intubation; SGA, supraglottic airway; RR, risk ratio

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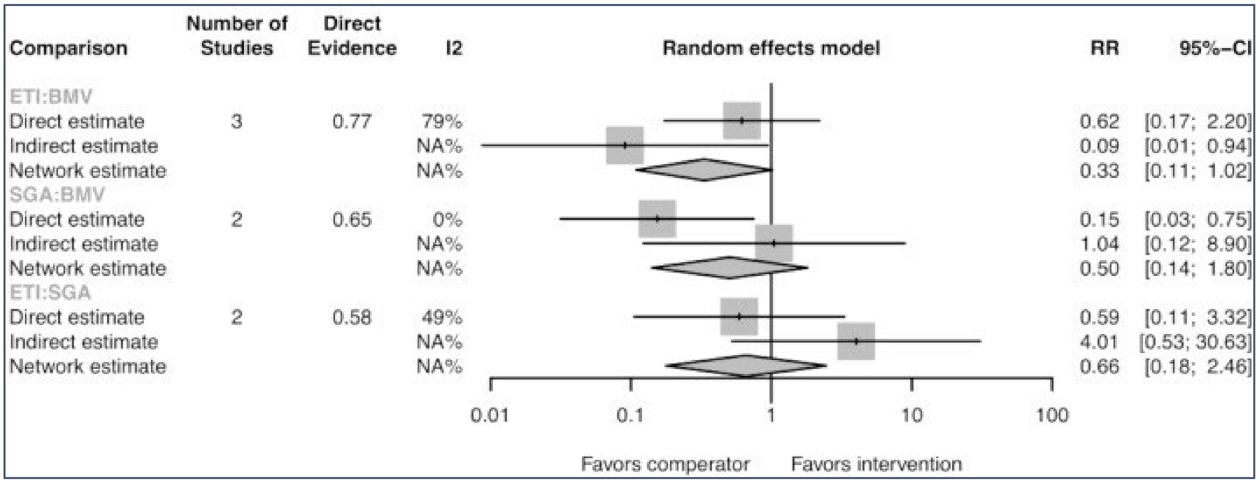
    - “Figure 4 (below). Forest plots of the direct comparison, indirect comparison, and network meta-analysis for favorable neurological outcome. We did not find any significant association. BMV, bag-mask ventilation; ETI, endotracheal intubation; SGA, supraglottic airway, CI, confidence interval.”



- “Supplementary Table 10 (below). Network estimate for favorable neurological outcomes in sensitivity analysis: observational studies with appropriate confounding adjustment”

Supplementary Table 10. Network estimate for favorable neurological outcomes in sensitivity analysis: observational studies with appropriate confounding adjustment

Comparison	Direct estimate RR (95% Cl)	Indirect estimate RR (95% Cl)	Network estimate RR (95% Cl)	Certainty of evidence for network meta-analysis
ETI vs. BMV	0.44 (0.23–0.84)	0.25 (0.11–0.61)	0.36 (0.21–0.60)	Low
SGA vs. BMV	0.42 (0.22–0.79)	0.73 (0.30–1.75)	0.55 (0.33–0.92)	Low
ETI vs. SGA	0.61 (0.33–1.11)	1.06 (0.43–2.64)	0.65 (0.40–1.08)	Very low

BMV, bag-mask ventilation; ETI, endotracheal intubation; SGA, supraglottic airway; RR, risk ratio

- “Our results suggest that compared to BMV, ETI and SGA do not lead to improved patient survival and favorable neurological outcomes at hospital discharge or 1 month after cardiac arrest. However, the certainty of the evidence is low to very low, and there is no conclusive evidence regarding the effectiveness of AAM during prehospital pediatric cardiopulmonary resuscitation”

- **Quality of Evidence/Limitations:**
    - “The risk of bias of one clinical trial was high due to the randomization process, whereas that of the four observational studies was determined to be moderate.”
    - “Most of the available evidence was provided by observational studies and only one clinical trial. The clinical trial, which was conducted >20 years ago, allocated interventions according to even or odd days, and interventions were performed by emergency medicine service personnel.”

Bansal SC, et al. **The Laryngeal Mask Airway and Its Use in Neonatal Resuscitation: A Critical Review of Where We Are in 2017/2018**. Neonatology. 2018;113(2):152-161. LINK

- **Objective/Research Question**:
  - "In this article, we will review the available literature on the use of the LMA in newborns, providing an overview for readers. We aim to explore the various indications of the LMA and point out any gaps in knowledge, in order to generate a direction for future studies."
- **Results/Discussion:**
  - "…results indicating that initial respiratory management of newborn infants with an LMA is feasible for a defined subgroup of infants, but the evidence is still insufficient to recommend the LMA instead of [face mask (FM)] ventilation in the DR."
  - "There were no reports on significant complications following the use of LMA; however, evidence is still limited regarding short- and long-term outcomes. We conclude that the limited currently available evidence suggests that the use of the LMA is a feasible and safe alternative to mask ventilation of late preterm and term infants in the DR. The potential use of LMA resuscitation, in particular for low-gestation and low-birth-weight infants, needs further study."
- **Quality of Evidence/Limitations:**
  - "There is, in particular, a dearth of evidence of the use of LMA in neonates born before 34 weeks' gestational age or weighing <1,500 g at birth."

Koers L, et al. **The emergency paediatric surgical airway: A systematic review**. Eur J Anaesthesiol. 2018 Aug;35(8):558-565. doi: 10.1097/EJA.0000000000000813. PMID: 29708907. LINK

- **Objective/Research Question**:
  - "…the major problem with regards to the paediatric cannot intubate, cannot oxygenate (CICO) scenario is that there is currently no evidence regarding the best technique for performing a paediatric emergency surgical airway."
  - "The aim of this study was to give an overview of current literature with regard to the best technique to perform a surgical airway in a paediatric CICO scenario."
- **Results/Discussion:**
  - "Table 3 (below): Aggregated results for mean time placement, success rate and complication rate for different surgical airway techniques from original studies."

	Mean time placement (s)	Success rate	Complication rate
Catheter over needle	44[17]	43% (10/23)[17,19]	34% (3/10)[17 a]
Wire-guided	Not reported[b]	100% (16/16)[18]	69% (11/16)[18]
Cannula	67.3[15,16]	56% (87/154)[15,16,19]	36% (55/151)[15,19]
Scalpel and bougie	108.7[15,16]	88% (51/58)[15,16,18]	38% (18/48)[15,19]

[a] Stacey *et al.*[19] did not report complication rate as failure rate was 100%. [b] No time was reported for the wire-guided technique.

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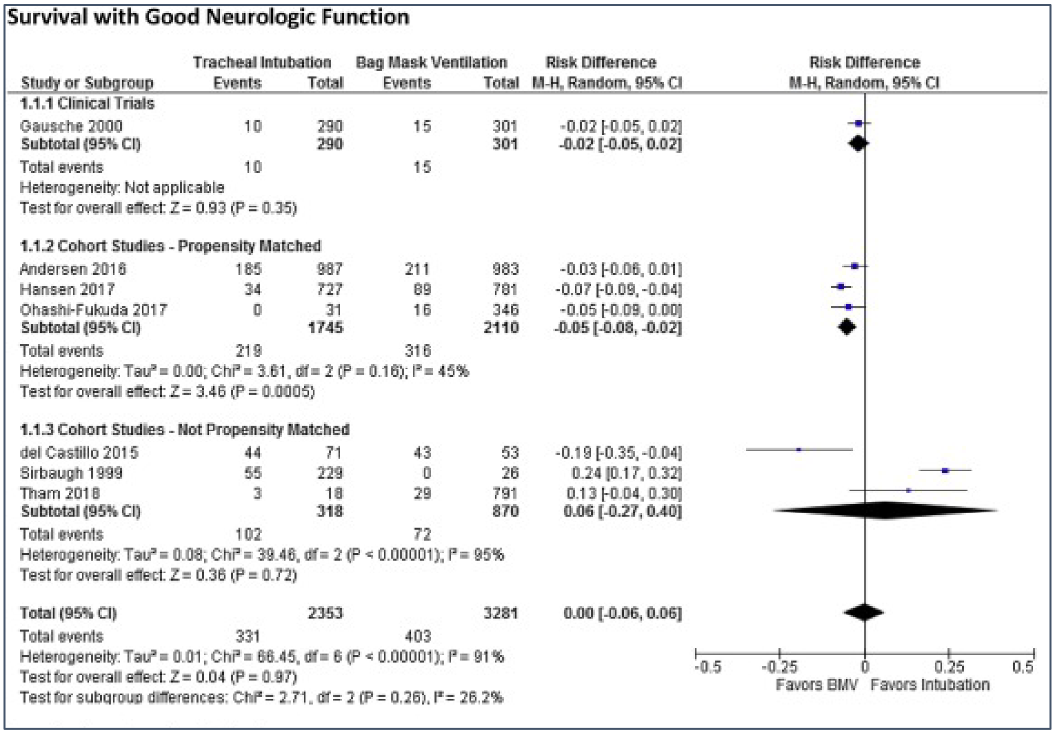
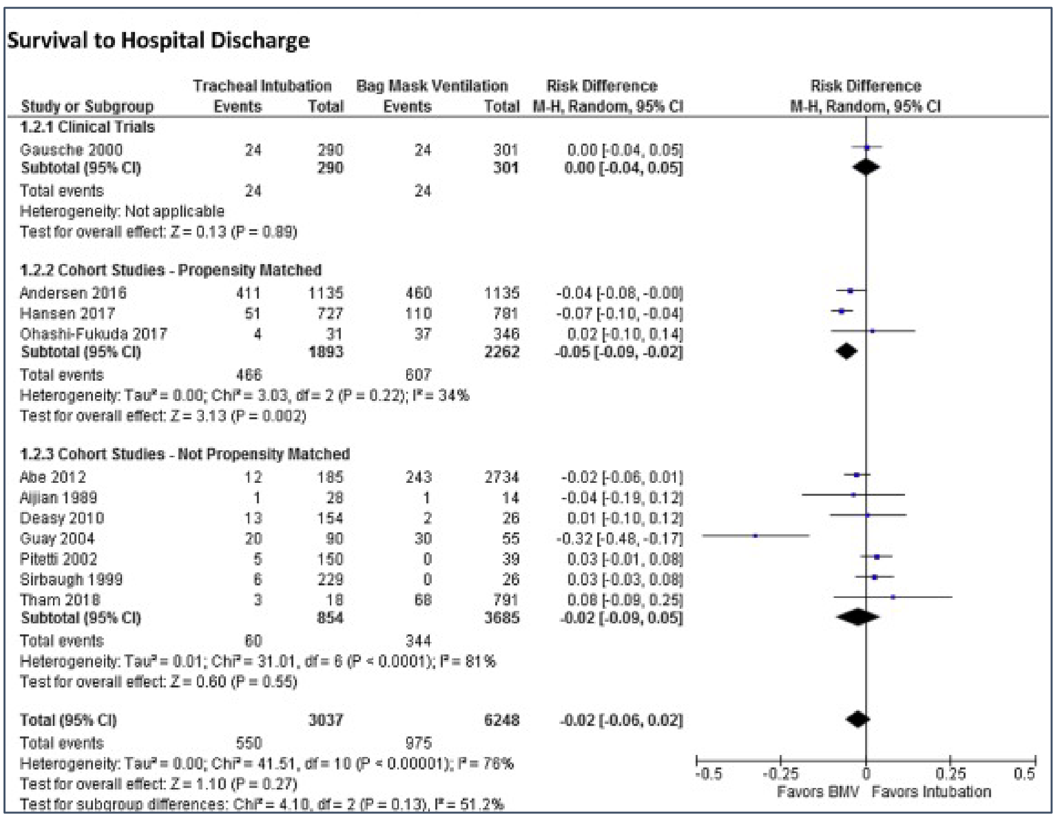
  - "From the available evidence, the strength of the catheter over the needle technique is that it is fast which offers the advantage of establishing an airway rapidly in a paediatric

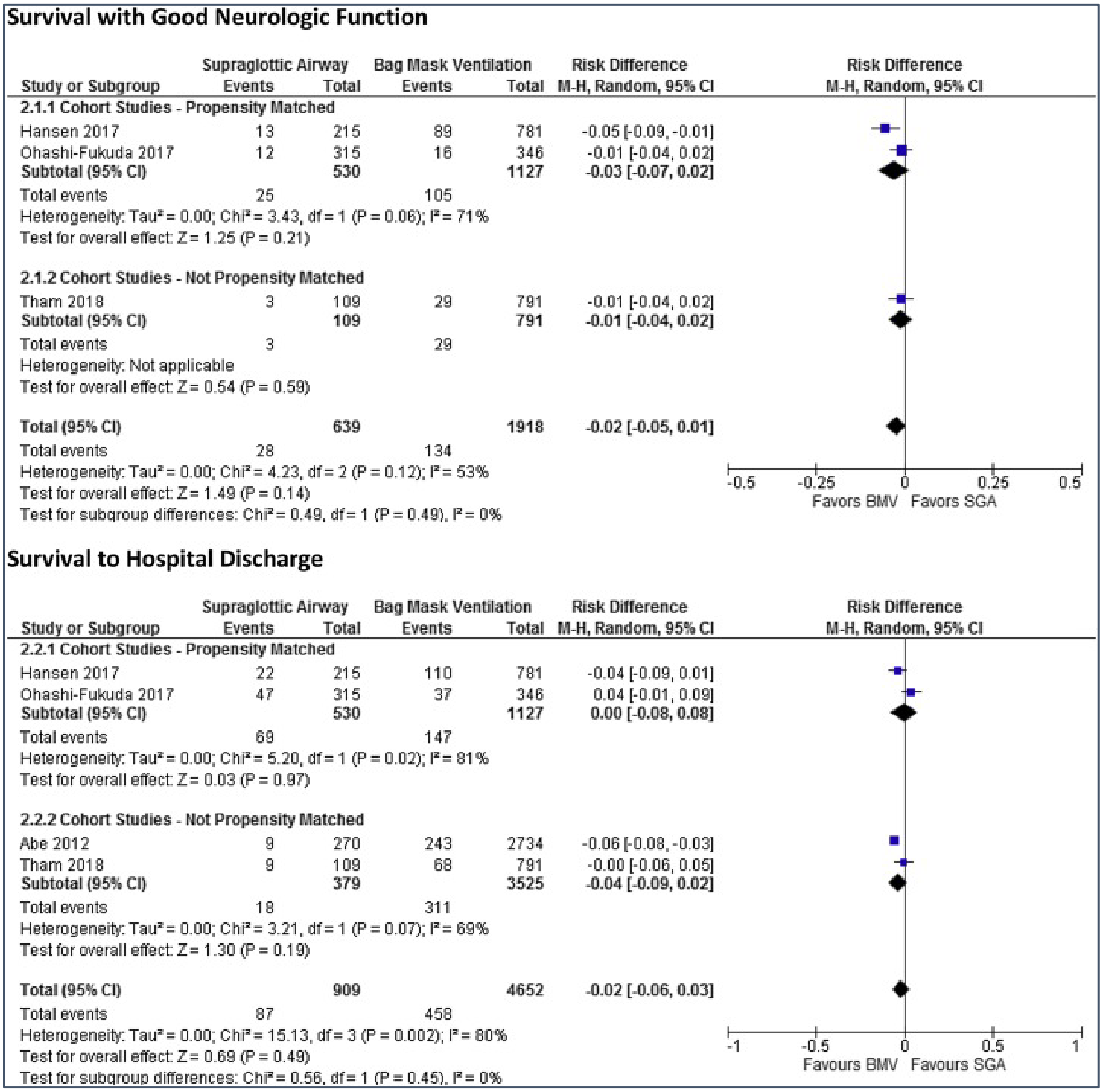
CICO. The complication rate described is the lowest of all the techniques. However, it has a very high failure rate, so this technique has the disadvantage of a high likelihood of not being able to provide tracheal access at all. The wire-guided technique has a high first attempt success rate reported. Procedural time was not reported. The disadvantage of this technique is a high complication rate. The reported outcomes for the cannula technique indicate one of the lowest complication rates of all techniques. However, from the available evidence, this procedure has a high failure rate rendering uncertainty as to whether an airway can be established in a paediatric CICO. High success rates are described for the scalpel technique, complication rates are amongst the lowest among the four techniques. Reported procedural time is longer however."
        - *See Discussion for SWOT analysis of all five included studies.*
    - "The absence of best practice evidence necessitates further studies in a standardised format to provide a clear advice on best practice management for the paediatric emergency surgical airway in the CICO crisis."
- **Quality of Evidence/Limitations:**
    - Animal models only

Lavonas EJ, et al, and the International Liaison Committee on Resuscitation (ILCOR) Pediatric Life Support Task Force. **Advanced airway interventions for paediatric cardiac arrest: A systematic review and meta-analysis**. Resuscitation. 2019 May;138:114-128. LINK

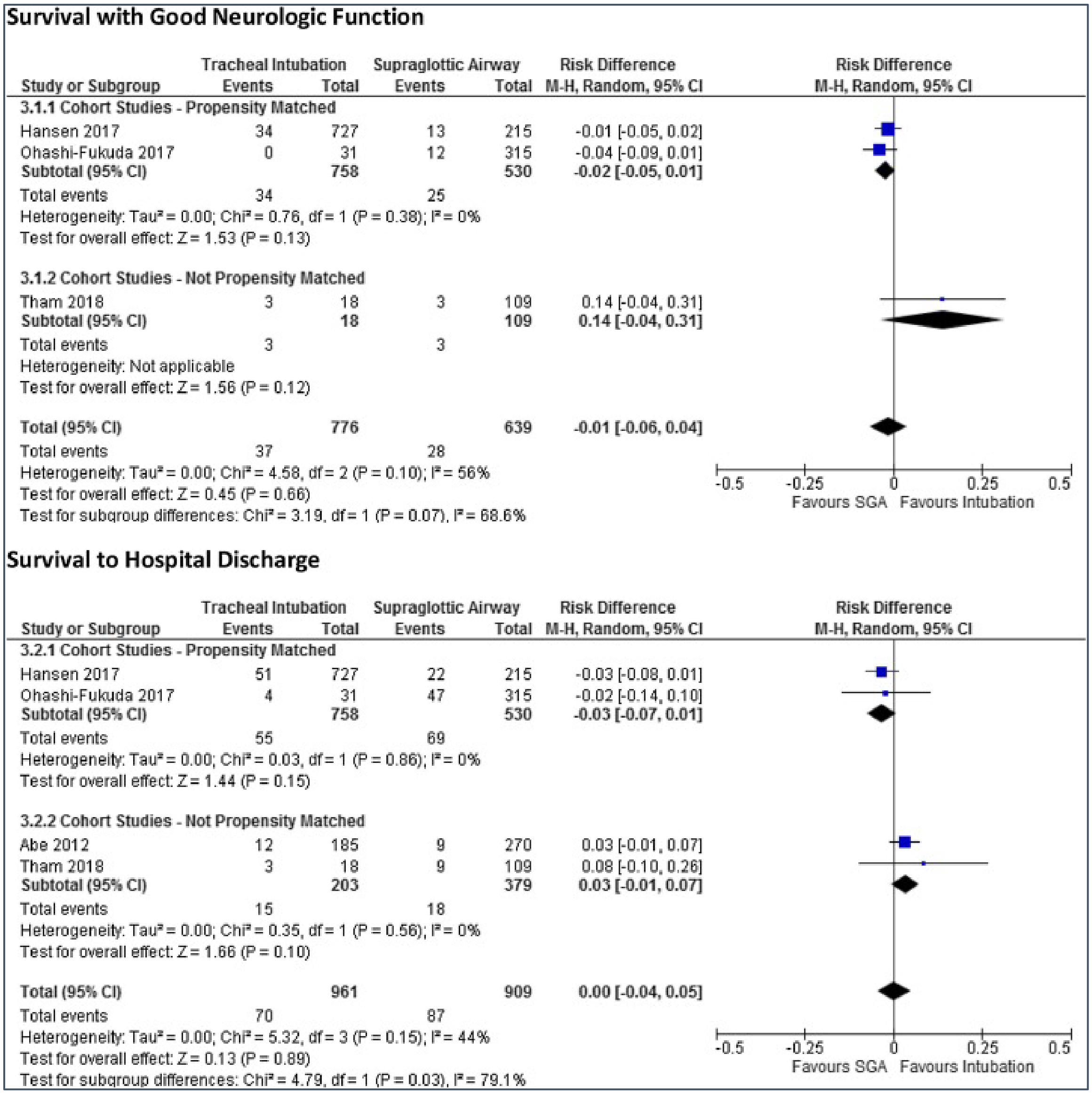
- **Objective/Research Question**:
    - "To assess the use of advanced airway interventions (tracheal intubation (TI) or supraglottic airway (SGA) placement), compared with bag mask ventilation (BMV) alone, for resuscitation of children in cardiac arrest."
    - "This systematic review and meta-analysis was commissioned by the ILCOR Pediatric Life Support Task Force (PLS TF) in order to determine whether AAW interventions (TI and/or SGA placement) improve outcomes in resuscitation from cardiac arrest in children when compared to BMV or each other."
- **Results/Discussion:**
    - "Figure 2 (below, next page). Forest plots comparing tracheal intubation to bag mask ventilation for the critical outcomes of survival with good neurologic function and survival to hospital discharge. BMV: bag mask ventilation. M−H = Cochran–Mantel–Haenszel. 95% CI: 95 percent confidence interval."

- 
Survival with Good Neurologic Function
Tracheal Intubation | Bag Mask Ventilation | Risk Difference | Risk Difference
Study or Subgroup | Events | Total | Events | Total | M-H, Random, 95% CI | M-H, Random, 95% CI
1.1.1 Clinical Trials
Gausche 2000 10 290 15 301 -0.02 [-0.05, 0.02]
Subtotal (95% CI) 290 301 -0.02 [-0.05, 0.02]
Total events 10 15
Heterogeneity: Not applicable
Test for overall effect: Z = 0.93 (P = 0.35)
1.1.2 Cohort Studies - Propensity Matched
Andersen 2016 185 987 211 983 -0.03 [-0.06, 0.01]
Hansen 2017 34 727 89 781 -0.07 [-0.09, -0.04]
Ohashi-Fukuda 2017 0 31 16 346 -0.05 [-0.09, 0.00]
Subtotal (95% CI) 1745 2110 -0.05 [-0.08, -0.02]
Total events 219 316
Heterogeneity: Tau² = 0.00; Chi² = 3.61, df = 2 (P = 0.16); I² = 45%
Test for overall effect: Z = 3.46 (P = 0.0005)
1.1.3 Cohort Studies - Not Propensity Matched
del Castillo 2015 44 71 43 53 -0.19 [-0.35, -0.04]
Sirbaugh 1999 55 229 0 26 0.24 [0.17, 0.32]
Tham 2018 3 18 29 791 0.13 [-0.04, 0.30]
Subtotal (95% CI) 318 870 0.06 [-0.27, 0.40]
Total events 102 72
Heterogeneity: Tau² = 0.08; Chi² = 39.46, df = 2 (P < 0.00001); I² = 95%
Test for overall effect: Z = 0.36 (P = 0.72)
Total (95% CI) 2353 3281 0.00 [-0.06, 0.06]
Total events 331 403
Heterogeneity: Tau² = 0.01; Chi² = 66.45, df = 6 (P < 0.00001); I² = 91%
Test for overall effect: Z = 0.04 (P = 0.97)
Test for subgroup differences: Chi² = 2.71, df = 2 (P = 0.26), I² = 26.2%
-0.5 -0.25 0 0.25 0.5
Favors BMV Favors Intubation
- 
Survival to Hospital Discharge
Tracheal Intubation | Bag Mask Ventilation | Risk Difference | Risk Difference
Study or Subgroup | Events | Total | Events | Total | M-H, Random, 95% CI | M-H, Random, 95% CI
1.2.1 Clinical Trials
Gausche 2000 24 290 24 301 0.00 [-0.04, 0.05]
Subtotal (95% CI) 290 301 0.00 [-0.04, 0.05]
Total events 24 24
Heterogeneity: Not applicable
Test for overall effect: Z = 0.13 (P = 0.89)
1.2.2 Cohort Studies - Propensity Matched
Andersen 2016 411 1135 460 1135 -0.04 [-0.08, -0.00]
Hansen 2017 51 727 110 781 -0.07 [-0.10, -0.04]
Ohashi-Fukuda 2017 4 31 37 346 0.02 [-0.10, 0.14]
Subtotal (95% CI) 1893 2262 -0.05 [-0.09, -0.02]
Total events 466 607
Heterogeneity: Tau² = 0.00; Chi² = 3.03, df = 2 (P = 0.22); I² = 34%
Test for overall effect: Z = 3.13 (P = 0.002)
1.2.3 Cohort Studies - Not Propensity Matched
Abe 2012 12 185 243 2734 -0.02 [-0.06, 0.01]
Aijian 1989 1 28 1 14 -0.04 [-0.19, 0.12]
Deasy 2010 13 154 2 26 0.01 [-0.10, 0.12]
Guay 2004 20 90 30 55 -0.32 [-0.48, -0.17]
Pitetti 2002 5 150 0 39 0.03 [-0.01, 0.08]
Sirbaugh 1999 6 229 0 26 0.03 [-0.03, 0.08]
Tham 2018 3 18 68 791 0.08 [-0.09, 0.25]
Subtotal (95% CI) 854 3685 -0.02 [-0.09, 0.05]
Total events 60 344
Heterogeneity: Tau² = 0.01; Chi² = 31.01, df = 6 (P < 0.0001); I² = 81%
Test for overall effect: Z = 0.60 (P = 0.55)
Total (95% CI) 3037 6248 -0.02 [-0.06, 0.02]
Total events 550 975
Heterogeneity: Tau² = 0.00; Chi² = 41.51, df = 10 (P < 0.00001); I² = 76%
Test for overall effect: Z = 1.10 (P = 0.27)
Test for subgroup differences: Chi² = 4.10, df = 2 (P = 0.13), I² = 51.2%
-0.5 -0.25 0 0.25 0.5
Favors BMV Favors Intubation

- "Figure 3 (below). Forest plots comparing supraglottic airway placement to bag mask ventilation for the critical outcomes of survival with good neurologic function and survival to hospital discharge."



- "Figure 4 (below). Forest plots comparing tracheal intubation to supraglottic airway placement for the critical outcomes of survival with good neurologic function and survival to hospital discharge."



- “Overall, these results suggest with low to very low certainty that TI-based resuscitation is not superior to BMV-based resuscitation for cardiac arrest in children for the critically important outcomes of survival to hospital discharge and survival to hospital discharge with good neurologic outcomes.”
- “No clinical trial studied the impact of SGA placement on resuscitation outcomes; the best available evidence is observational and of very low certainty.”
- “Based on small and contradictory evidence base of very low certainty, it appears that critically important outcomes for children in cardiac arrest are not significantly different with TI resuscitation compared to SGA resuscitation.”
  - *Additional sub-group analyses are available in the publication.*
- “…the current available data suggest, with low to very low certainty, that the critical outcomes of survival with good neurologic outcome and survival to hospital discharge

are not significantly better when resuscitation is performed with TI or SGA, compared with BMV alone."
    - "Based on low to very low certainty evidence, the use of TI or SGA in resuscitation does not appear to improve the critically important resuscitation outcomes of survival to hospital discharge and survival to hospital discharge with good neurologic outcomes in children in cardiac arrest."
- **Quality of Evidence/Limitations:**
    - "The risk of bias in each study is presented in the Supplemental materials [see here, page 18]"
    - "Despite major differences in study design and setting, there was little heterogeneity in study results. Small numbers of subjects in many studies and the low proportion of patients with good outcome contribute to imprecision in the estimate of treatment effect for most comparisons."
    - "Unmeasured factors, such as the training or experience level of the person performing airway management and ventilation, may be more important than the choice of technique or device. In addition, the benefit or harm associated with AAW-based resuscitation is likely to differ between settings. The available data do not inform the questions of whether better outcomes might be achieved by AAW-based strategies in long distance transportation/prolonged resuscitation situations, with highly experienced airway operators, when video laryngoscopy is utilized, if AAW placement is only attempted when BMV is difficult, etc. The analyzed data are only relevant to AAW interventions during CPR, and do not pertain to airway management in other critical situations."

Qureshi MJ, Kumar M. **Laryngeal mask airway versus bag-mask ventilation or endotracheal intubation for neonatal resuscitation**. Cochrane Database of Systematic Reviews 2018, Issue 3. LINK

- **Objective/Research Question**:
    - "Among all newborns requiring positive pressure ventilation for cardiopulmonary resuscitation, is effective positive pressure ventilation and successful resuscitation achieved faster with the laryngeal mask airway (LMA) compared to bag-mask ventilation (BMV)?"
    - "When BMV is either insufficient or ineffective, is effective positive pressure ventilation and successful resuscitation achieved faster with LMA compared to endotracheal intubation?"
- **Results/Discussion:**
    - "LMA can achieve effective ventilation during neonatal resuscitation in a time frame consistent with current guidelines and could be more effective than BMV in resuscitation settings."
    - "Results show that compared to the BMV, the use of LMA is more effective in terms of lower need for endotracheal intubation and shorter ventilation time. Infants initiated on

BMV were more likely to fail the primary modality of providing positive pressure ventilation, although, some could be rescued by LMA, thus preventing endotracheal intubation. Compared to endotracheal intubation, the use of LMA was not associated with clinically significant differences in insertion time or failure to correctly place the device. Both techniques provided effective ventilation with no difference in the short-term clinical outcomes observed. However, most studies included infants with birth weights over 1500 g or 34 or more weeks gestation or both. Evidence relating to less mature infants is limited."
    - "LMA is technically a harder skill to learn as compared to BMV. Although, there was low failure rate in the included trials in terms of ability to initiate LMA in the participants, it is not clear whether same would be the case in real world settings given that LMA is technically a more challenging skill to learn compared to BMV."
    - "We found that in term and near-term infants, LMA is more effective during resuscitation resulting in less need for endotracheal intubation and shorter ventilation time compared with BMV. Compared to endotracheal intubation, the use of LMA was not associated with clinically significant difference in insertion time or failure to correctly place the device."
- **Quality of Evidence/Limitations:**
    - Evidence quality ranged from very low- to moderate-quality.

Weihing VK, et al. **Prehospital airway management in the pediatric patient: A systematic review**. Acad Emerg Med. 2022 Jun;29(6):765-771. LINK

- **Objective/Research Question**:
    - "Critically ill children may require airway management to optimize delivery of oxygen and ventilation during resuscitation. We performed a systematic review of studies comparing the use of bag-valve-mask ventilation (BVM), supraglottic airway devices (SGA), and endotracheal intubation (ETI) in pediatric patients requiring prehospital airway management."
    - "While ample data describe the course and outcome of adult prehospital airway management, there have been few attempts to synthesize similar information in the pediatric population (see here for reference). We sought to conduct a systematic review to identify and characterize studies of prehospital BVM, supraglottic airway devices (SGA), and/or ETI use in children and their associations with outcomes."
- **Results/Discussion:**
    - "In this systematic review, studies of prehospital pediatric airway management varied in scope, design, and conclusions. There was insufficient evidence to evaluate efficacy of pediatric prehospital airway management; however, the current research suggests that there are equal or worse outcomes with the use of ETI compared to other airway techniques. Additional clinical trials are needed to assess the merits of this practice."

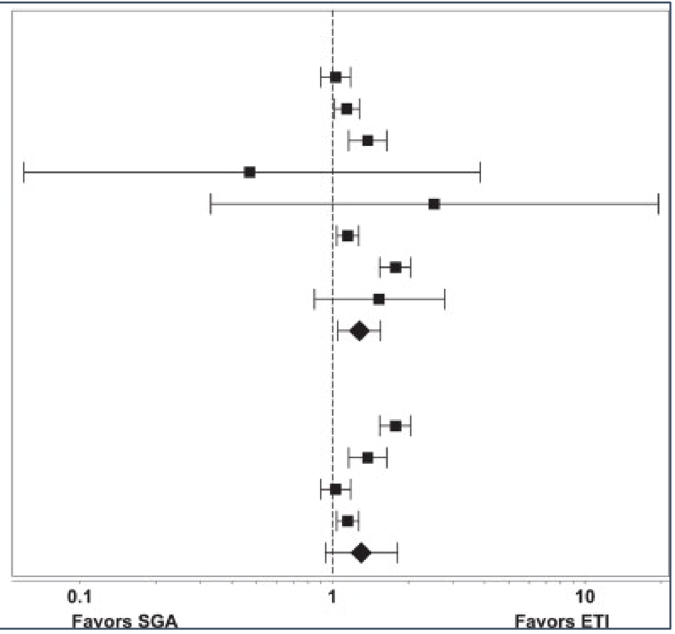
- “Compared airway techniques varied between BVM, ETI, and SGA. While the quality of the studies was insufficient to justify a meta-analysis, they consistently demonstrated similar or worse outcomes with ETI compared with BVM or SGA.”
    - “Perhaps the most important observation is that inferences from observational studies are limited and potentially influenced by confounding-by-indication. For example, while meta-analyses of observational adult OHCA data identify better outcomes with ETI than SGA, subsequent clinical trials, the Pragmatic Airway Resuscitation Trial and the Airways-2 Trial, found equal or better outcomes with SGA than ETI, underscoring the importance of randomization in evaluating ETI outcomes.”
    - “There are also important anatomic and physiologic distinctions in children, including the relative size of the tongue, position and angle of the glottis, and varying chest compliance and pulmonary reserve that increase the difficulty of airway management. These distinctions make children prone to upper-airway obstruction and desaturation during periods of apnea, but also vary with age, suggesting that stratification by age may be important in pediatric airway studies.18 Jarvis et al.19 found that prehospital first-pass ETI success varied with age.”
- **Quality of Evidence/Limitations:**
    - “The included papers were largely retrospective cohorts, with one prospective cohort and only one randomized controlled trial. Although the results of such observational studies may be influenced by confounders, they are the best representation of available data and were therefore included.”

Adult Patients

Benoit JL, Gerecht RB, Steuerwald MT, McMullan JT. **Endotracheal intubation versus supraglottic airway placement in out-of-hospital cardiac arrest: A meta-analysis**. Resuscitation. 2015 Aug;93:20-6. LINK

- **Objective/Research Question**:
    - “The objective of this study was to determine the comparative effectiveness of ETI versus SGA [supraglottic airway, which includes LMA] after OHCA [out-of-hospital cardiac arrest] using meta-analysis techniques. Specifically, we addressed the following question: In adult, non-traumatic OHCA patients who receive advanced airway management by paramedics in the prehospital setting, is ETI associated with worse patient outcomes when compared to SGA? We hypothesized that ETI would have decreased rates of all major cardiac arrest outcomes, including neurologically intact survival to hospital discharge.”
- **Results/Discussion:**
    - “Figure 2 (below, next page). Forest plot for return of spontaneous circulation. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of “very low” quality.”

Study	N (ETI)	N (SGA)	OR (95% CI)
FULL MODEL:			
Cady 2009	4335	1487	1.03 (0.90-1.18)
Kajino 2011	1679	3698	1.14 (1.02-1.28)
McMullan 2014	5591	3110	1.38 (1.16-1.64)
Nagao 2012	10	189	0.47 (0.06-3.58)
Noda 2007	4	24	2.53 (0.33-19.53)
Tanabe 2013	12992	29640	1.15 (1.04-1.27)
Wang 2012	8487	1968	1.78 (1.54-2.04)
Yanagawa 2010	158	478	1.53 (0.85-2.78)
TOTAL	33256	40594	1.28 (1.05-1.55)
SENSITIVITY ANALYSIS MODEL:			
Wang 2012	8487	1968	1.78 (1.54-2.04)
McMullan 2014	5591	3110	1.38 (1.16-1.64)
Cady 2009	4335	1487	1.03 (0.90-1.18)
Tanabe 2013	12992	29640	1.15 (1.04-1.27)
TOTAL	31405	36205	1.30 (0.94-1.81)



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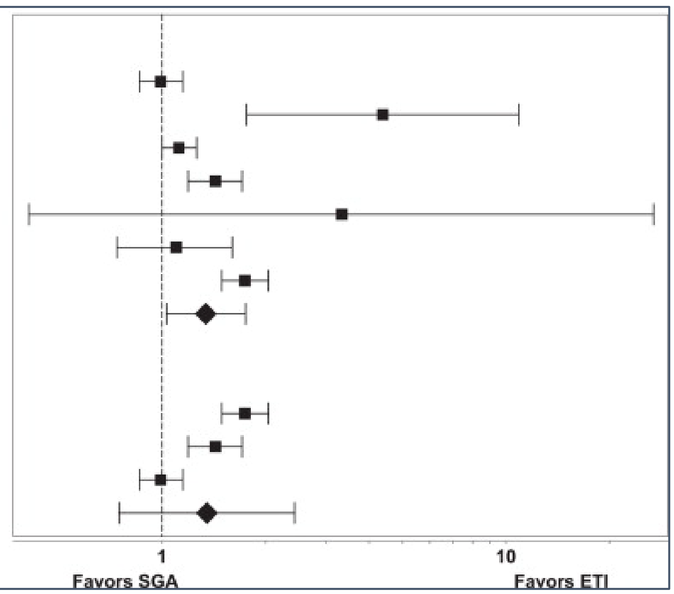
  - "Figure 3 (below). Forest plot for survival to hospital admission. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of "very low" quality."

Study	N (ETI)	N (SGA)	OR (95% CI)
FULL MODEL:			
Cady 2009	4335	1487	0.99 (0.86-1.15)
Hanif 2010	1027	131	4.38 (1.76-10.88)
Kajino 2011	1679	3698	1.12 (1.00-1.26)
McMullan 2014	5591	3110	1.43 (1.19-1.71)
Noda 2007	4	24	3.33 (0.41-26.86)
Shin 2012	250	391	1.1 (0.74-1.6)
Wang 2012	8487	1968	1.74 (1.49-2.04)
TOTAL	21373	10809	1.34 (1.03-1.75)
SENSITIVITY ANALYSIS MODEL:			
Wang 2012	8487	1968	1.74 (1.49-2.04)
McMullan 2014	5591	3110	1.43 (1.19-1.71)
Cady 2009	4335	1487	0.99 (0.86-1.15)
TOTAL	18413	6565	1.35 (0.75-2.43)



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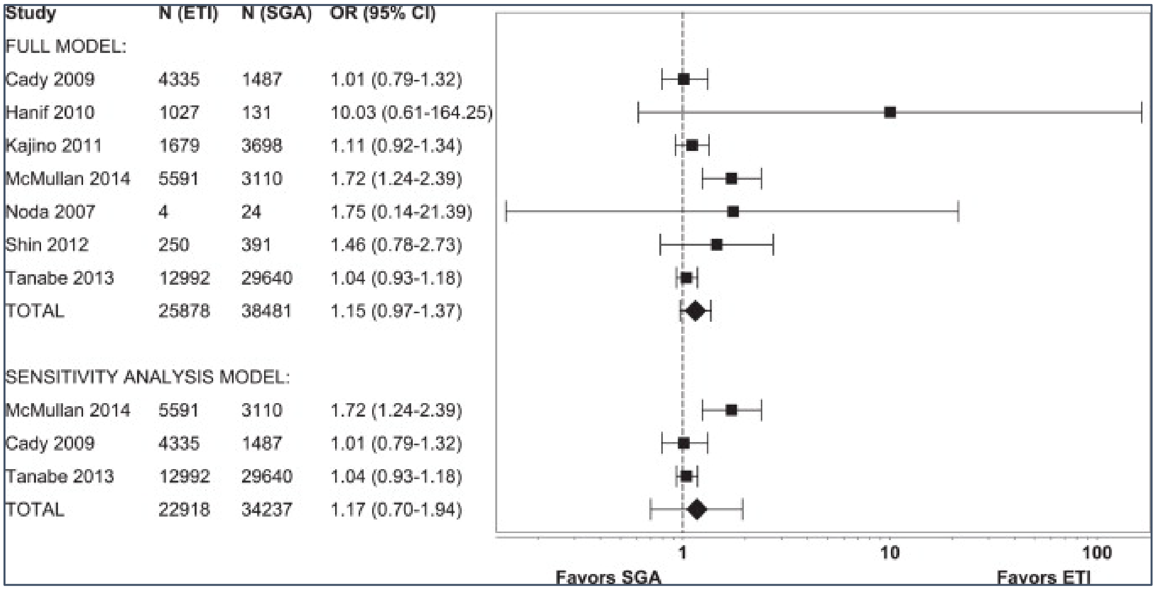
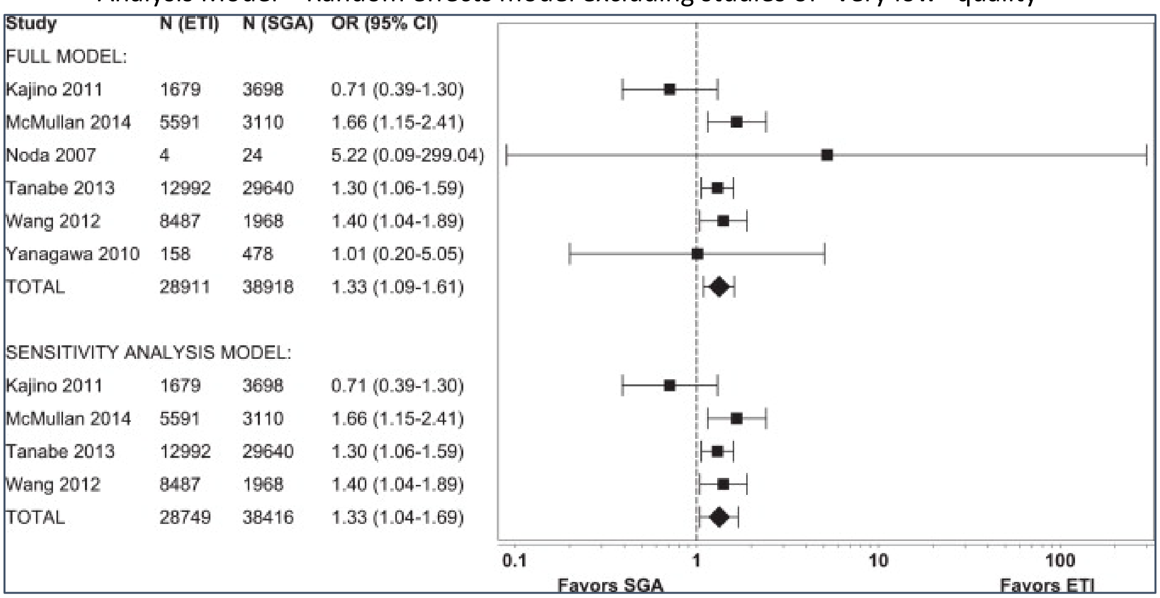
  - "Figure 4 (below, next page). Forest plot for survival to hospital discharge. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of "very low" quality."

- 

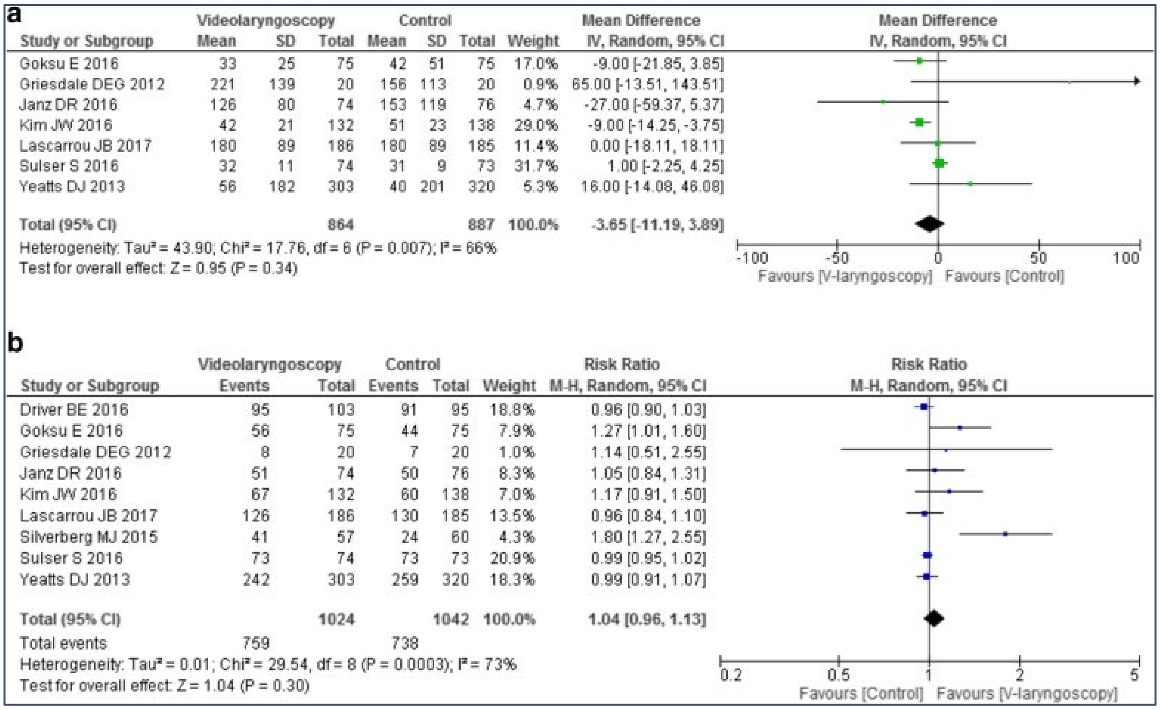
  - “Figure 5 (below). Forest plot for neurologically intact survival to hospital discharge. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of “very low” quality”
- 

  - “Our meta-analysis of 10 studies shows that ETI is associated with improved outcomes after OHCA when compared to SGA. Although the effect sizes are small, they are consistent across outcomes after OHCA, including proximal outcomes occurring minutes after cardiac arrest (e.g., ROSC) and distal outcomes that are not apparent until days to weeks after the cardiac arrest event (e.g., neurologically intact survival to hospital discharge.)”

- **Quality of Evidence/Limitations:**
  - "The main limitation of this meta-analysis is that no randomized controlled trials exist comparing these two airway interventions, resulting in an overall low quality of evidence."
  - "In addition, the exact course of airway events during resuscitation efforts was rarely reported. It is possible that some patients may have received SGA after failed ETI, which could result in decreased survival if CPR was interrupted or hypoxia occurred. However, the study by Wang et al. specifically looked at this concern, and demonstrated no significant difference in the comparative effectiveness of ETI versus SGA even after adjusting for failed airway attempts."

Cabrini L, et al. **Tracheal intubation in critically ill patients: a comprehensive systematic review of randomized trials**. Crit Care. 2018 Jan 20;22(1):6. Erratum in: Crit Care. 2019 Oct 21;23(1):325. LINK

- **Objective/Research Question**:
  - "We performed a systematic review of randomized controlled studies evaluating any drug, technique or device aimed at improving the success rate or safety of tracheal intubation in the critically ill."
- **Results/Discussion:**
  - "We identified 22 trials on use of a pre-procedure check-list (1 study), pre-oxygenation or apneic oxygenation (6 studies), sedatives (3 studies), neuromuscular blocking agents (1 study), patient positioning (1 study), video laryngoscopy (9 studies), and post-intubation lung recruitment (1 study). Pre-oxygenation with non-invasive ventilation (NIV) and/or high-flow nasal cannula (HFNC) showed a possible beneficial role. Post-intubation recruitment improved oxygenation, while ramped position increased the number of intubation attempts and thiopental had negative hemodynamic effects. No effect was found for use of a checklist, apneic oxygenation (on oxygenation and hemodynamics), videolaryngoscopy (on number and length of intubation attempts), sedatives and neuromuscular blockers (on hemodynamics). Finally, videolaryngoscopy was associated with severe adverse effects in multiple trials."
  - Figure 1 (below, next page): Videolaryngoscopy vs. direct laryngoscopy: forest plot for intubation time (a) and for first-attempt successful intubation (b)



a

Study or Subgroup	Videolaryngoscopy Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Goksu E 2016	33	25	75	42	51	75	17.0%	-9.00 [-21.85, 3.85]
Griesdale DEG 2012	221	139	20	156	113	20	0.9%	65.00 [-13.51, 143.51]
Janz DR 2016	126	80	74	153	119	76	4.7%	-27.00 [-59.37, 5.37]
Kim JW 2016	42	21	132	51	23	138	29.0%	-9.00 [-14.25, -3.75]
Lascarrou JB 2017	180	89	186	180	89	185	11.4%	0.00 [-18.11, 18.11]
Sulser S 2016	32	11	74	31	9	73	31.7%	1.00 [-2.25, 4.25]
Yeatts DJ 2013	56	182	303	40	201	320	5.3%	16.00 [-14.08, 46.08]
Total (95% CI)			**864**			**887**	**100.0%**	**-3.65 [-11.19, 3.89]**

Heterogeneity: Tau² = 43.90; Chi² = 17.76, df = 6 (P = 0.007); I² = 66%
Test for overall effect: Z = 0.95 (P = 0.34)

b

Study or Subgroup	Videolaryngoscopy Events	Total	Control Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Driver BE 2016	95	103	91	95	18.8%	0.96 [0.90, 1.03]
Goksu E 2016	56	75	44	75	7.9%	1.27 [1.01, 1.60]
Griesdale DEG 2012	8	20	7	20	1.0%	1.14 [0.51, 2.55]
Janz DR 2016	51	74	50	76	8.3%	1.05 [0.84, 1.31]
Kim JW 2016	67	132	60	138	7.0%	1.17 [0.91, 1.50]
Lascarrou JB 2017	126	186	130	185	13.5%	0.96 [0.84, 1.10]
Silverberg MJ 2015	41	57	24	60	4.3%	1.80 [1.27, 2.55]
Sulser S 2016	73	74	73	73	20.9%	0.99 [0.95, 1.02]
Yeatts DJ 2013	242	303	259	320	18.3%	0.99 [0.91, 1.07]
Total (95% CI)		**1024**		**1042**	**100.0%**	**1.04 [0.96, 1.13]**
Total events	759		738			

Heterogeneity: Tau² = 0.01; Chi² = 29.54, df = 8 (P = 0.0003); I² = 73%
Test for overall effect: Z = 1.04 (P = 0.30)

-
    - "Our findings imply that, in hypoxemic patients, time permitting, pre-oxygenation by NIV and/or HFNC could offer the best safety profile; post-intubation RM can further enhance arterial oxygenation. The sniffing position might be the position of choice for laryngoscopy. Thiopental should be avoided, above all in hemodynamically unstable patients."
    - "The limited available evidence supports a beneficial role of pre-oxygenation with NIV and HFNC before intubation of critically ill patients. Recruitment maneuvers may increase post-intubation oxygenation. Ramped position increased the number of intubation attempts; thiopental had negative hemodynamic effects and videolaryngoscopy might favor adverse events."
- **Quality of Evidence/Limitations:**
    - "The main limitation of the present systematic review is its inability to offer robust suggestions about crucial areas. In particular, no RCT evaluated the role and compared the performance of different scores to predict difficult intubation, the best monitoring and equipment, the role of supervision, the best associated drugs (in particular the role of propofol, a commonly used sedative), the best way to face predicted and unpredicted difficult airways scenarios, the role of fiber optic bronchoscopy and supraglottic devices, the best strategy to confirm tracheal intubation, and how to prevent or treat hemodynamic instability."

Carney N, et al. **Prehospital Airway Management: A Systematic Review**. Rockville (MD): Agency for Healthcare Research and Quality (US); 2021 Jun. Report No.: 21-EHC023. LINK

- **Objective/Research Question**:
  - "To assess the comparative benefits and harms across three airway management approaches (bag valve mask [BVM], supraglottic airway [SGA], and endotracheal intubation [ETI]) by emergency medical services in the prehospital setting, and how the benefits and harms differ based on patient characteristics, techniques, and devices."
- **Results/Discussion:**
  - See Table A: Overview of conclusions: comparisons by emergency types and age groups (LINK) for summary.
  - "The overall findings suggested that there are few differences in primary outcomes between the three methods of airway management studied. Similarly, few differences were found in studies that compared variations of one type of airway (e.g., video versus direct laryngoscopy)."
  - "For survival, there was moderate Strength of Evidence [SOE] for findings of no difference for BVM versus ETI in adult and mixed-age cardiac arrest patients. There was low SOE for no difference in these patients for BVM versus SGA and SGA versus ETI. There was low SOE for all three comparisons in pediatric cardiac arrest patients, and low SOE in adult trauma patients when BVM was compared with ETI."
  - "For neurological function, there was moderate SOE for no difference for BVM compared with ETI in adults with cardiac arrest. There was low SOE for no difference in pediatric cardiac arrest for BVM versus ETI and SGA versus ETI. In adults with cardiac arrest, neurological function was better for BVM and ETI compared with SGA (both low SOE)."
  - "ROSC was applicable only in cardiac arrest. For adults, there was low SOE that ROSC was more frequent with SGA compared with ETI, and no difference for BVM versus SGA or BVM versus ETI. In pediatric patients there was low SOE of no difference for BVM versus ETI and SGA versus ETI."
  - "For successful advanced airway insertion, low SOE supported better first-pass success with SGA in adult and pediatric cardiac arrest patients and adult patients in studies that mixed emergency types. Low SOE also supported no difference for first-pass success in adult medical patients. For overall success, there was moderate SOE of no difference for adults with cardiac arrest, medical, and mixed emergency types."
  - "While harms were not always measured or reported, moderate SOE supported all available findings. There were no differences in harms for BVM versus SGA or ETI. When SGA was compared with ETI, there were no differences for aspiration, oral/airway trauma, and regurgitation; SGA was better for multiple insertion attempts; and ETI was better for inadequate ventilation."
  - "Overall, this review found no strongly supported differences in primary outcomes, with most of the results being "no difference" across the three common methods of airway management in prehospital care. Whereas this may be due in part to study limitations,

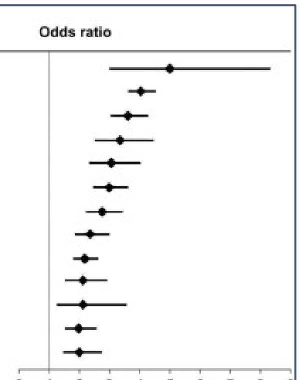
it also may reflect the reality that no one airway approach is consistently more effective across different patient needs and the widely variable prehospital environment. Attempting to derive algorithmic protocols that identify single approach recommendations based solely on effectiveness may not be possible or desirable given this heterogeneity."

- **Quality of Evidence/Limitations:**
    - "We identified and pooled studies that compared primary outcomes for different types of airway management used in prehospital care. Given the challenges of this environment, the size of the body of evidence was a key strength."
    - "The most important limitations were weaker observational study designs, rendering them vulnerable to indication and survival biases. Bias, confounding, and incomplete data are difficult to avoid, given the dynamic nature of airway management in the field."

Hung KC, et al. **Prevalence and risk factors of difficult mask ventilation: A systematic review and meta-analysis**. J Clin Anesth. 2023 Nov. LINK

- **Objective/Research Question**:
    - "This meta-analysis aimed at identifying the risk factors for and their strengths in predicting difficult mask ventilation (MV) through a systematic approach."
    - "Through a systematic review of the published retrospective and prospective studies from different countries, the current meta-analysis aimed at identifying the commonly reported risk factors for difficult MV as well as investigating their strengths as predictors of difficult MV in the OR setting."
- **Results/Discussion:**
    - "The results of analysis of the strength of predictors revealed that all of the predictors were associated with a significantly higher incidence of difficult MV compared to that in the control groups (Figure 2, below). Among all the predictors, a history of neck radiation was associated with the highest risk of difficult MV, followed by the presence of an increased neck circumference and the diagnosis of OSA."

Parameter	Number of studies	Number of patients	Odds ratio	95% CI	*p* value	I²
Neck radiation	5	277 843	5.00	[3.00, 8.33]	0.00001	51%
Increased neck circmference	11	247 871	4.04	[3.62, 4.53]	0.00001	0%
Obstructive sleep apnea	12	331 255	3.61	[3.04, 4.29]	0.00001	48%
Presence of beard	12	295 443	3.35	[2.51, 4.46]	0.00001	73%
Snoring	14	296 105	3.06	[2.32, 4.04]	0.00001	84%
Obesity	11	278 297	2.99	[2.46, 3.62]	0.00001	64%
Male gender	16	320 512	2.76	[2.22, 3.43]	0.00001	80%
Mallampati score III–IV	17	335 016	2.36	[1.86, 3.00]	0.00001	84%
Limited mouth opening	6	291 795	2.18	[1.80, 2.63]	0.00001	0%
Short TMD	6	328 311	2.12	[1.53, 2.93]	0.00001	74%
Edentulous	11	249 821	2.12	[1.26, 3.57]	0.005	85%
Limited neck movement	9	155 101	1.98	[1.53, 2.57]	0.00001	50%
Old age	11	278 750	2.00	[1.46, 2.75]	0.00001	51%



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    - "Our results identified a history of neck radiation (OR = 5) as the strongest predictive risk factor, followed by the presence of an increased neck circumference (OR = 4.04) and

OSA (OR = 3.61). Although the most well-studied risk factors were Mallampati score III-IV (17 studies) and male gender (16 studies), they were independently associated with only approximately twofold higher odds of difficult MV."

- **Quality of Evidence/Limitations:**
    - "…removal of one study at a time through sensitivity analysis showed consistent results of the 13 risk factors, indicating no significant impact from a single study on the overall outcomes (Figure not shown). The publication bias assessment was performed on nine predictors, which indicated a low risk in each of these outcomes (Supplemental Figs. 14–22)."
    - "First, the lack of a set of standard criteria for defining and grading difficult MV, which was partly subjective and operator-dependent among the included studies, may bias our findings. Second, although a previous investigation reported that the use of neuromuscular blockade may facilitate MV [42], relevant information was not available in most of our included studies and the timing of administration was not mentioned among other studies with available information. Therefore, the confounding effect of muscle relaxant remains unclear. Third, variations in the definitions of predictors of difficult MV across the included studies (e.g., old age and obesity) may introduce heterogeneity that biased our study outcomes."

Lai CJ, Yeh YC, Tu YK, Cheng YJ, Liu CM, Fan SZ. **Comparison of the efficacy of supraglottic airway devices in low-risk adult patients: a network meta-analysis and systematic review**. Sci Rep. 2021 Jul 23;11(1):15074. LINK

- **Objective/Research Question**:
    - "We therefore conducted a systematic review and network meta-analysis to evaluate the efficacy of [supraglottic airway devices] SADs in terms of [oropharyngeal leak pressure] OLP, the risk of first-attempt insertion failure, postoperative sore throat rate (POST) and other efficacy-associated outcomes, including overall insertion failure rate during induction, poor function after successful insertion, SAD failure during maintenance, hypoxia and aspiration."
- **Results/Discussion:**
    - See Table 2 for "Results for oropharyngeal leak pressure from network meta-analysis"
    - See Table 3 for "Results for the risk of first-attempt insertion failure from network meta-analysis and pairwise meta-analysis."
    - See Table 4 for "Results for postoperative sore throat rate from network meta-analysis and pairwise meta-analysis."
    - "Meta-regression analysis revealed that using [neuromuscular blocking agents] NMBAs was negatively associated with the risk of first-attempt insertion failure, and positively associated with OLP, but not associated with POST."
    - "Compared with the [classic laryngeal mask airway] C-LMA, many SADs achieved a significantly higher OLP, with a mean difference ranging from 3.98 to 9.18 cmH2O. The

Protector achieved the highest OLP and ranked the best among the SADs. All SAD exhibited similar risks of first-attempt insertion failure, and not significant differences in POST compared with those of the C-LMA."
    - "Our results revealed that all SADs exhibited similar risks of first-attempt insertion failure to that of the C-LMA, consistent with the results of a previous network meta-analysis on pediatric patients."
    - "In conclusion, SADs including the Proseal LMA, I-gel, Supreme LMA, Streamlined Liner of the Pharynx Airway, SoftSeal, Cobra Perilaryngeal Airway, Air-Q, Laryngeal Tube, and Laryngeal Tube Suction II (LTS-II), Laryngeal Tube Suction Disposable (LTS-D), Protector, and AuraGain, achieve significantly higher OLP and similar risks of first-attempt insertion failure compared with those of the C-LMA."
- **Quality of Evidence/Limitations:**
    - "Our study has several strengths. Rather than grouping various SADs into one group, we assessed the efficacy of each SAD individually and compares them within the same evidence base."
    - "This study had some limitation. First, the data in our network meta-analysis were mostly derived from low risk, elective, nonobese patients with a low risk of aspiration. Second, some of our efficacy-related outcomes were reported by a limited number of studies with zero events, thereby resulting in greater uncertainty in our assessment of these outcomes. Third, some of the included studies did not report on NMBA use with SADs, affecting the strength of the meta-regression results on NMBA effects. Fourth, we performed a grey literature search but did not identify additional relevant studies that met our inclusion criteria. Fifth, many anesthetic agents have been developed, and anesthetic strategies have changed over the last 30 years since the C-LMA was developed."

Lou J, et al. **Airway management in out-of-hospital cardiac arrest: A systematic review and network meta-analysis**. Am J Emerg Med. 2023 Mar;65:130-138. doi: 10.1016/j.ajem.2022.12.029. Epub 2022 Dec 29. PMID: 36630861. LINK

- **Objective/Research Question**:
    - "Airway management during cardiopulmonary resuscitation is particularly important for patients with out-of-hospital cardiac arrest (OHCA). This study was performed to compare the efficacy of the most commonly used out-of-hospital airway management methods in increasing the survival to discharge in patients with OHCA."
- **Results/Discussion:**
    - "As the gold standard of airway management for patients with out-of-hospital cardiac arrest in most countries, endotracheal intubation (ETI) has been widely used for many years. However, our systematic review and network meta-analysis showed that ETI is no better than other methods in increasing the survival to discharge. This is not directly proportional to the various preparations required before ETI. Additional randomized

controlled trials are needed to identify more effective methods and improve patients' outcome"

- **Quality of Evidence/Limitations:**
  - "Although six airway management methods were studied in the present research, only nine RCTs were included. Because these articles did not include an influential factor analysis, we were unable to perform a subgroup analysis."

Qamarul Hoda M, et al. **ProSeal versus Classic laryngeal mask airway (LMA) for positive pressure ventilation in adults undergoing elective surgery**. Cochrane Database Syst Rev. 2017 Jul 20;7(7):CD009026. LINK

- **Objective/Research Question**:
  - "To compare the effectiveness of the ProSeal laryngeal mask airway (pLMA) and the Classic LMA (cLMA) for positive pressure ventilation in adults undergoing elective surgery."
- **Results/Discussion:**
  - "We are uncertain about the effects of either of the airway devices in terms of failure of oxygenation or ventilation because there were very few events. Results were uncertain in terms of differences for several complications. Low-quality evidence suggests that the ProSeal laryngeal mask airway makes a better seal and therefore may be more suitable than the Classic laryngeal mask airway for positive pressure ventilation. The Classic laryngeal mask airway may be quicker to insert, but this is unlikely to be clinically meaningful."
- **Quality of Evidence/Limitations:**
  - "We assessed all of the included studies as providing low-quality evidence because anaesthetists knew which device was being used on which participants (although this was probably unavoidable), and because it was unclear whether the investigator who collected the data was unaware of the intervention. This fact created the potential for bias."

Seung HY, Beirne OR. **Laryngeal mask airways have a lower risk of airway complications compared with endotracheal intubation: a systematic review**. Journal of oral and maxillofacial surgery. 2010 Oct 1;68(10):2359-76. LINK

- **Objective/Research Question**:
  - "The purpose of the present study was to determine whether, in patients undergoing general anesthesia, those provided with a laryngeal mask airway (LMA) have a lower risk of airway-related complications than those undergoing endotracheal intubation."
  - "The objective of the present study was to update the previous meta-analysis and to identify and analyze recent clinical trials that compared the LMA and ETT in patients

receiving general anesthesia. Well-designed, controlled trials comparing the LMA and ETT were identified, and the results from the different studies were combined to determine whether clinically significant differences were present in the respiratory complications associated with the ETT and LMA."

- **Results/Discussion:**
    - "Figure 2 (below). A, Incidence of laryngospasm during emergence. B, Funnel plot of comparison of LMA and ETT for outcome of laryngospasm during emergence. C, Sensitivity analysis of incidence of laryngospasm during emergence."

Wang CH, et al. **Comparing Effectiveness of Initial Airway Interventions for Out-of-Hospital Cardiac Arrest: A Systematic Review and Network Meta-analysis of Clinical Controlled Trials**. Ann Emerg Med. 2020 May;75(5):627-636. LINK

- **Objective/Research Question**:
    - "We compare effectiveness of different airway interventions during cardiopulmonary resuscitation for patients with out-of-hospital cardiac arrest."
    - "Given that the results of several large-scale randomized controlled trials have already been published, we performed a network meta-analysis of clinical trials to compare different initial airway interventions for out-of-hospital cardiac arrest patients in improving survival and neurologic outcomes."
- **Results/Discussion:**
    - "The network meta-analysis indicated no significant differences among intubation, supraglottic airway, or bag-valve-mask ventilation in regard to patient survival to hospital discharge (Table 2)."
    - "For the secondary outcomes, supraglottic airway improved the rate of return of spontaneous circulation compared with intubation (OR 1.11; 95% CI 1.03 to 1.20) or bag-valve-mask ventilation (OR 1.35; 95% CI 1.11 to 1.63), and intubation improved the rate of return of spontaneous circulation compared with bag-valve-mask ventilation (OR 1.21; 95% CI 1.01 to 1.44) (Table 2, Figure E3)."
    - "However, there were no differences among these airway interventions in regard to neurologic outcome (Table 2, Figure E4)."
    - "The network meta-analysis indicated there were no differences between these interventions in regard to survival or neurologic outcome at hospital discharge. Nevertheless, network meta-analysis demonstrated that supraglottic airway improved the rate of return of spontaneous circulation compared with intubation or bag-valve-mask ventilation, and intubation improved the rate of return of spontaneous circulation compared with bag-valve-mask ventilation. A probability analysis ranked supraglottic airway as the most effective method for improving the rate of return of spontaneous circulation, followed by intubation as the second-best method."
    - "Contrary to the rank order suggested by our network meta-analysis, previous meta-analyses of observational studies suggested that for out-of-hospital cardiac arrest

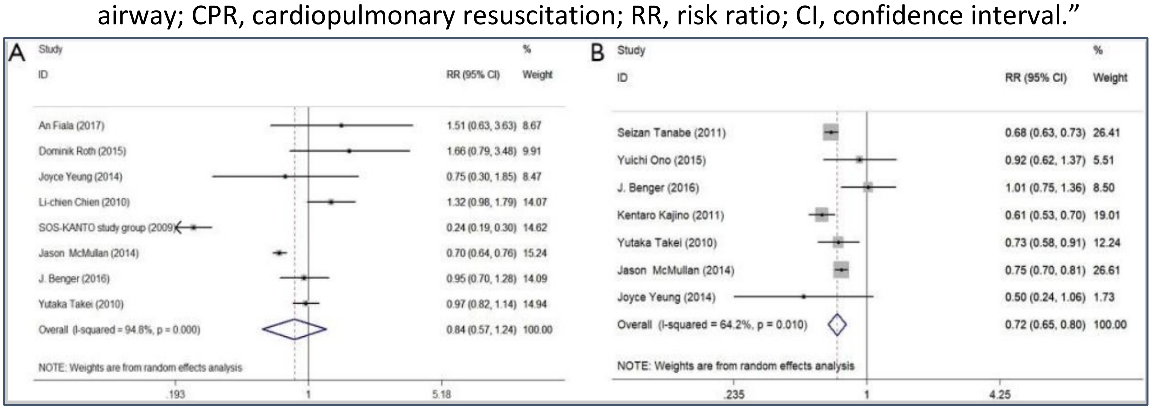
patients, bag-valve-mask ventilation was the most effective method of airway management, followed by intubation and then supraglottic airway”
    - “Although there were no differences in survival to hospital discharge or neurologic outcome among these airway interventions, these system-based comparisons demonstrated that supraglottic airway was better than intubation or bag-valve-mask ventilation and intubation was better than bag-valve-mask ventilation in improving return of spontaneous circulation. The intubation success rate greatly influenced the meta-analytic results, and therefore these comparison results should be interpreted with these system differences in mind.”
- **Quality of Evidence/Limitations:**
    - “There was no visually remarkable asymmetry of the funnel plot, indicating the absence of significant publication bias (Figure E5).”
    - “To avoid confounding by indications inherent in observational studies, the current network meta-analysis included only randomized controlled trials or quasi randomized controlled trials. Nonetheless, among these included studies, there were substantial differences present in the out-of-hospital care systems. For example, in the 2 studies with intubation success rates higher than the third quartile, physicians were responsible for the out-of-hospital cardiac arrest resuscitation.”
    - “First, because of the number of included trials, we could not perform subgroup analyses according to different types of supraglottic airway; therefore, we are unable to recommend a specific type of supraglottic airway. Second, according to consensus of the International Liaison Committee on Resuscitation,18 we selected only intubation success rate as a reference to separate studies into different groups in sensitivity analyses. Intubation success rate might be a practical reference for formulating policies in regard to which advanced airway intervention should be adopted. Third, as outlined in the sensitivity analyses, the study by Jabre et al greatly influenced the meta-analytic results because of the high intubation success rate and its unique position in the network geometry, providing the only direct comparison between intubation and bag-valve-mask ventilation.”

White L, et al. **Advanced airway management in out of hospital cardiac arrest: A systematic review and meta-analysis**. Am J Emerg Med. 2018 Dec;36(12):2298-2306. LINK

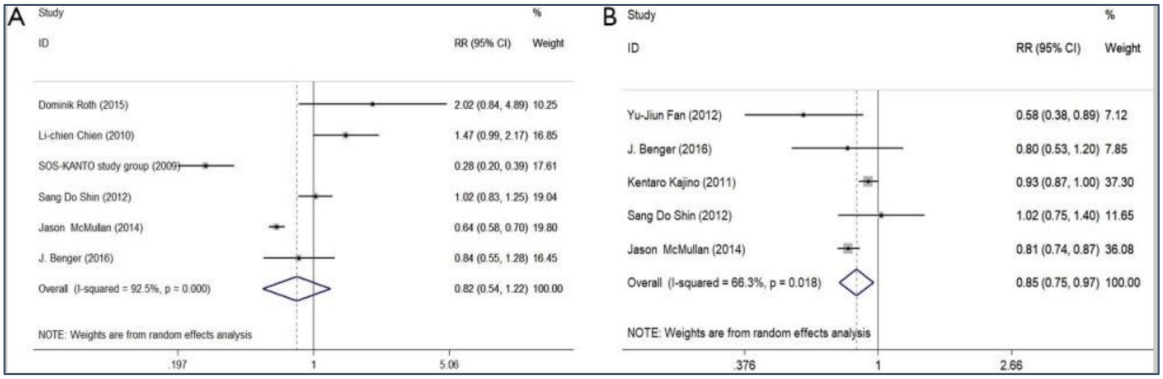
- **Objective/Research Question**:
    - “To assess the difference in survival and neurological outcomes between endotracheal tube (ETT) intubation and supraglottic airway (SGA) devices used during out-of-hospital cardiac arrest (OHCA).”
- **Results/Discussion:**
    - “This was the largest and most up to date systematic review and meta-analysis on airway management in OHCA, with 29 studies and 539,146 patients included. Overall, ETT demonstrated better early survival rates (ROSC and survival to admission) than SGA

devices. Despite the improved early survival rates, there was no significant in longer term outcomes such as survival to discharge and neurological function at discharge from hospital. The clinical application of the overall improvements in early survival with the use of ETT is limited due to the significant heterogeneity (I2 = 91%). This reflects the multifactorial nature of both cardiac arrest aetiology and management. For this reason multiple sensitivity analyses were performed."
  - "The overall heterogeneous benefit in survival with ETT was not replicated in the low risk RCTs, with no significant difference in survival or neurological outcome. In the presence of automated chest compressions, ETT intubation may result in survival benefits."
- **Quality of Evidence/Limitations:**
  - "The predominant limitation to this review is the lack of RCTs and a significant number of retrospective studies from overlapping databases. On the subgroup analysis removing the overlapping studies, this did not affect any of the results. This inconsistency of reported outcomes has been highlighted in critical care literature remains a significant limitation to the conclusions drawn from the present study. Furthermore, the five RCTs utilized different supraglottic airways, which may impact the overall outcome."

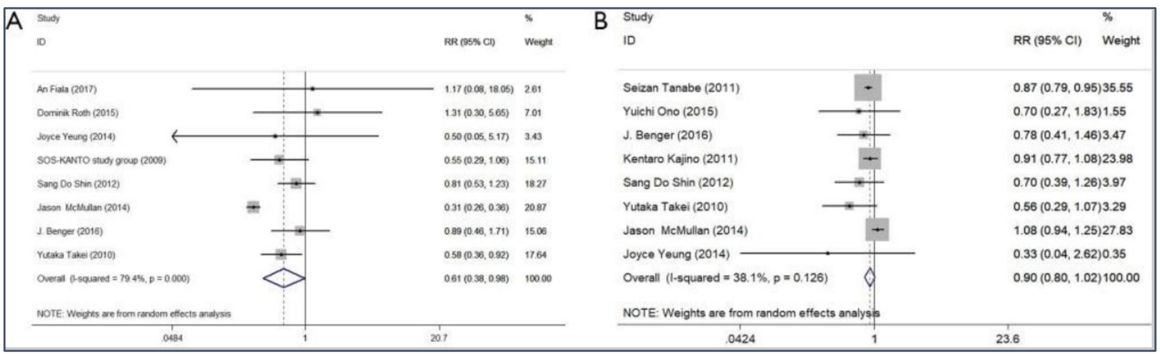
Yang Z, et al. **Comparing the efficacy of bag-valve mask, endotracheal intubation, and laryngeal mask airway for subjects with out-of-hospital cardiac arrest: an indirect meta-analysis**. Ann Transl Med. 2019 Jun;7(12):257. LINK

- **Objective/Research Question**:
  - "In this study, we aimed to comprehensively evaluate the efficacy of BVM, ETI, and LMA in rescuing adult cardiac arrest by performing a meta-analysis and indirect comparison of these three methods of ventilation."
- **Results/Discussion:**
  - Figure 3 (below): "Forest plot of return of spontaneous circulation. (A) LMA *vs.* BVM; (B) LMA *vs.* ETI. BVM, bag-valve mask; ETI, endotracheal intubation; LMA, laryngeal mask airway; CPR, cardiopulmonary resuscitation; RR, risk ratio; CI, confidence interval."
- 

- Figure 4 (below): “Forest plot of survive to admission. (A) LMA vs. BVM; (B) LMA vs. ETI. BVM, Bag-valve mask; ETI, endotracheal intubation; LMA, laryngeal mask airway; CPR, cardiopulmonary resuscitation; RR, risk ratio; CI, confidence interval.”



- Figure 5 (below): “Forest plot of survive to discharge. (A) LMA *vs.* BVM; (B) LMA *vs.* ETI. BVM, bag-valve mask; ETI, endotracheal intubation; LMA, laryngeal mask airway; CPR, cardiopulmonary resuscitation; RR, risk ratio; CI, confidence interval.”



- “In our analysis, although without significance, the use of ETI offered an absolute higher survival rate for subjects with OHCA in comparison to BVM and LMA, in the meanwhile, ETI was also associated a higher success rate of recovery and the rate of hospital admission after successful recovery. However, from the trend of the forest plot, the success rate of recovery and the rate of live admission were similar for subjects treated with BVM and LMA. Therefore, for unskilled rescuers, to reduce the interruption time of chest compression and improve the success rate of resuscitation, BVM should be preferred for early CPR. But according to our study, ETI should be considered when the mask cannot be fixed to ensure ventilation or long-distance transportation.”
- “Our meta-analysis of the success rate of recovery, survival to admission rate, and survival to discharge rate of subjects with OHCA demonstrated that ETI is more beneficial than LMA for subjects with OHCA. This may be due to the following reasons. Firstly, LMA may shift the ventilation quality during transport and care of subjects. Secondly, pre-hospital first-responders are unfamiliar with the LMA procedure. Finally, in comparison with LMA, ETI can better manage airway secretions and reduce the aspiration of gastric reflux, which is helpful in improving the respiratory status of subjects.”

- **Quality of Evidence/Limitations:**
    - "There are several limitations to our study: firstly, not all included studies were prospective comparisons, leading to data deficiency and potential selection and reporting bias in some outcomes; secondly, the majority of included studies reported an insufficient follow-up period, consequently, we were unable to evaluate long-term outcomes, such as 1 year survival rate after OHCA; third, small-study effects refer to the pattern that small studies are more likely to report beneficial effect in the intervention arm, although the funnel plot showed there was no obvious study bias in our analysis, some small-sample studies could still potentially affect the outcomes; finally, we have to admit the methodology of ITC has limitation of estimating HR, substantially diminishing the statistical significance, thus its evidence level is not as strong as traditional meta-analysis."

Other Review Literature

Kelton DK, et al. **Real-time video telemedicine applications in the emergency department: a scoping review of literature**. Canadian Journal of Emergency Medicine. 2018 Nov;20(6):920-8. LINK

- **Objective/Research Question**:
    - "To collect and synthesize the literature describing the use of real-time video-based technologies to provide support in the care of patients presenting to emergency departments."
- **Results/Discussion:**
    - Conclusion: "Telemedicine support for emergency department physicians is an application with significant potential but is still lacking evidence supporting improved patient outcomes. Advances in technology, combined with more attractive price-points have resulted in widespread interest and implementation around the world. Applications of this technology that are currently being studied include support for minor treatment centres, patient transfer decision-making, management of acutely ill patients and scheduled teleconsultations."

Levin BS, et al. **Teleguidance Technology for Endotracheal Intubation: A Scoping Review**. Crit Care Explor. 2021 Dec 9;3(12):e0582. LINK

- **Objective/Research Question**:
    - "We conducted a scoping review to provide a synthesis of the available literature on teleguidance facilitated intubation. Specifically, we aimed to evaluate the feasibility, safety, and efficacy of teleguidance facilitated intubation given existing technology."
- **Results/Discussion:**
    - "Of 255 citations identified, 17 met eligibility criteria. Studies included prospective investigations and proof of technology reports. These studies were performed in clinical

and simulation environments. Five of the prospective investigations that examined time to intubation and intubation success rates. Multiple different commercially available and noncommercial teleconference software systems were used in these studies."

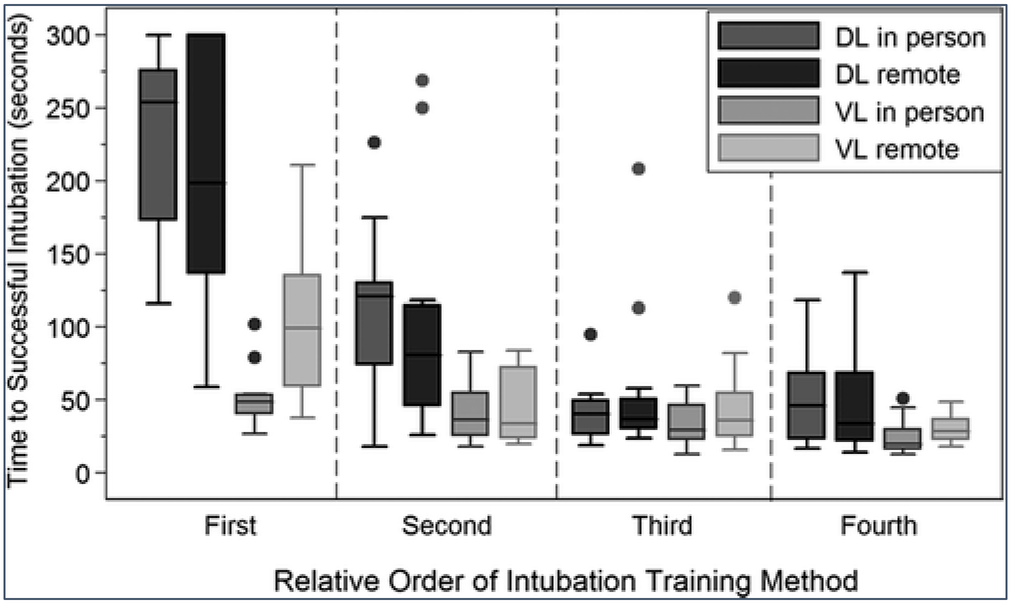
- *See Supplemental Table 1 for summaries of the 17 included studies, available here.*
- "The majority of published literature has focused on proof of technology demonstrations that allude to the benefits that might be achieved with clinical use."
- "Conclusion: "There is a limited body of literature evaluating the feasibility, safety, and efficacy of teleguidance facilitated intubation. Based on the studies available that examined a variety of technologies within simulation and clinical environments, teleguidance facilitated intubation appears to be feasible, safe, and efficacious."

- **Quality of Evidence/Limitations:**
  - "The number of published studies that have evaluated TFI is limited, and they were performed in a small number of environments by only a few investigators. Study selection was limited to available articles contained within three major medical databases. Studies that may be available in the gray literature including technical reports, proceedings, and theses were not examined. Finally, only articles published in English were included."

Primary Research Literature

Prescher H, et al. **Telepresent intubation supervision is as effective as in-person supervision of procedurally naive operators**. Telemed J E Health. 2015 Mar;21(3):170-5. LINK

- **Objective/Research Question**:
  - "This study aimed to compare the effectiveness of telepresent versus in-person supervision of tracheal intubation."
- **Results/Discussion:**
  - Results: "There was no significant difference between in-person and telepresent supervision for any of the outcomes. The median difference (in-person versus telepresent) for time to intubation was −3 s (95% confidence interval [CI], −20 to 14 s). The odds ratio for first attempt success was 0.7 (95% CI, 0.3–1.3), and the rate ratio for extra number of blade attempts (i.e., attempts in addition to first) was 1.1 (95% CI, 0.7–1.7) and 1.4 (95% CI, 0.9–2.2) for extra number of tube attempts."
  - "Figure 2 (below, next page). Box plot for time (s) to successful intubation for each method of training by order presented. Horizontal lines are median values, boxes represent interquartile range, I-bars represent 5th–95th percentile, and dots are values >95th percentile or <5th percentile (outliers). DL, direct laryngoscopy; VL, videolaryngoscopy."

- 

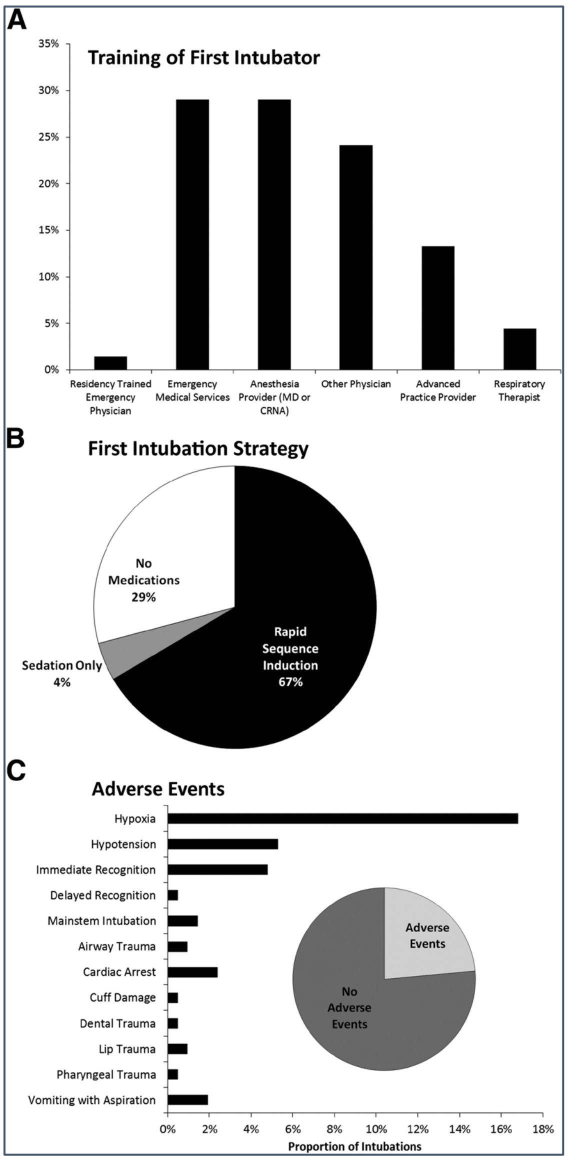
    - Conclusions: "In this study population of procedurally naive medical students, telepresent supervision was as effective as in-person supervision for tracheal intubation."
- **Quality of Evidence/Limitations:**
    - "During the DL trials, the research assistant was able to monitor the placement of the ETT and inform the participant of an esophageal intubation. In an actual intubation, this would not be possible. However, this problem is one inherent to DL, not the method of supervision (telepresent versus in-person). We did not record esophageal intubations as a separate outcome measure. However, the statistic is captured in the mean number of tube attempts, which does not differ significantly between telepresent and in-person instruction."

Van Oeveren L, et al. **Telemedicine-Assisted Intubation in Rural Emergency Departments: A National Emergency Airway Registry Study**. Telemed J E Health. 2017 Apr;23(4):290-297. LINK

- **Objective/Research Question**:
    - "The objective of this study is to describe telemedicine-assisted intubation in rural EDs that are served by a large ED telemedicine network in the upper Midwest (see here). Secondary objectives include comparing the success between intubations performed by direct laryngoscopy (DL) and VL, reporting the frequency of interventions using telemedicine consultation, and reporting complications and clinical outcomes."
- **Results/Discussion:**
    - "Over the 12-month period, 206 patient intubations were included in the registry from 99 hospitals. The most common indication for intubation was respiratory failure. The remotely observed first-pass success rate was 71% (n = 146), and 96% (n = 197) were successfully intubated (Fig. 2). Nearly all of those not ultimately intubated died in the

ED. More than half of all first attempts used VL (54%, n = 110), most commonly using the Glidescope (Verathon, Inc., Bothell, WA)."

- "The primary intubator was most commonly a physician without emergency medicine residency training, although a variety of provider types provided intubation services in rural EDs (Fig. 3 [see below]). First-pass success rate was no different in the VL group versus the DL group (70% vs. 71%, p = 0.802)."
- "Figure 3 (see below). Description of rural telemedicine-enabled intubations. (A) Training of the first person attempting the intubation after the activation of telemedicine, (B) medication strategy used for the first intubation attempt, and (C) rate and type of adverse events from airway management in rural hospitals in the telemedicine network.

- 

- “There is limited publishing on ED telemedicine experiences outside of established specialty support services such as tele-stroke. Although combining video technologies with patient evaluation makes sense, there are limited data supporting the impact of telemedicine on procedural outcomes. Others have reported that telemedicine has been used to support intubation practices [**references cited below**] using VL, but nearly all of these studies used simulation to test the telemedicine intervention. Even the studies that used in vivo observation were done in a tertiary setting to test a specific technology. This foundational body of knowledge suggests that supervision by telemedicine may be effective, but ours is the first to report on clinical outcomes in remote practice settings.”
    - Sakles JC, et al. **Telemedicine and telepresence for prehospital and remote hospital tracheal intubation using a GlideScope™ videolaryngoscope: a model for tele-intubation**. TELEMEDICINE and e-HEALTH. 2011 Apr 1;17(3):185-8. LINK
    - Boedeker BH, et al. **The Combined Use of Skype TM and the STORZ CMAC TM Video Laryngoscope in Field Intubation Training with the Nebraska National Air Guard**. InMedicine Meets Virtual Reality 18 2011 (pp. 83-85). LINK
    - Cho J, et al. **A pilot study of the Tele-Airway Management System in a hospital emergency department**. Journal of Telemedicine and Telecare. 2011 Jan;17(1):49-53. LINK
    - Chung HS, et al. **A comprehensive telemedicine system for remote guidance of emergency airway management**. Journal of Telemedicine and Telecare. 2007 Dec;13(3_suppl):29-32. LINK
    - Westwood JD. **Telementoring for airway management between a far forward special operations location to a major medical center using inexpensive telemedicine solutions**. Medicine Meets Virtual Reality 19: NextMed. 2012;173:212. LINK
- “Our findings further illustrate that telemedicine can improve care and enhance access to specialist support. Future research should focus on more robust scientific investigations to better understand the impact that telemedicine providers might have on intubation success and patient safety during emergency airway management.”
- “Telemedicine-enabled intubation performed in rural hospitals is feasible. Rural airway management success rates have never been previously reported, but telemedicine may provide additional benefit to patients who are being intubated in rural hospitals. Telemedicine consultation was the most often requested after intubation attempts had failed; however, the majority of subsequent remotely witnessed attempts were successful Adverse event rates are similar to those previously reported in other studies, and nearly all patients were ultimately intubated successfully. Future research is required to better define the impact of telemedicine providers on emergency airway management.”

- **Quality of Evidence/Limitations:**
    - Self-reported data, recall bias, no pre-intervention data available for comparison.